U. S. Department of Agriculture
Soil Conservation Service
Engineering Division

Technical Release No. 23
Design
November 16, 1964

ENGINEERING SERVICES CONTRACTS[1]

Introduction

Under Soil Conservation Service procurement policy, the administration of all contracts is a responsibility of the Administrative Officer. However, because of the special nature of engineering services contracts, almost every phase of their administration requires the application of engineering skills and judgment. The Government Representative appointed by the Contracting Officer must be a professional engineer with considerable experience in the fields of engineering relating to the work covered by the contract. Moreover, in order to provide effective staff assistance to the contracting officer, the government representative must be thoroughly familiar with procedures for planning the work, selecting qualified consultants, writing the contracts, negotiating the contracts, and for the technical control and review of the work.

The authorities for negotiating engineering services contracts are derived from the Federal Property and Administrative Services Act of 1949. Administrative procedures are explained in the Administrative Services Handbook and in Parts 2 and 3 of the Watershed Protection Handbook. Criteria for determining the propriety of accomplishing engineering work by use of such contracts are contained in current Engineering Memorandums.

It is the purpose of this technical release to: (1) emphasize engineering responsibilities; and, (2) provide more detailed examples of contract articles to supplement the exhibits in the Watershed Protection Handbook. The exhibits are not intended to be viewed as guide specifications, but rather as examples of the type and scope of specifications that Service experience has indicated are needed for effective contract administration.

Planning The Work

Prior to contract negotiation, the engineer must: (1) define the scope of the work to be done under the contract; (2) establish a reasonable time schedule for the performance of the work; and, (3) estimate a reasonable cost of the services.

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[1]This technical release was prepared by H. L. Cappleman, Jr., Assistant Chief, Design Branch.

DEFINING THE SCOPE OF THE CONTRACT

The definition of the scope of the contract must be based on a careful study and analysis of the magnitude and character of the work load, the assessment of Service capabilities in relation to the workload, and a consideration of how the contract work can be coordinated with the work of the Service or of the local sponsoring organizations, or both. To this end, the Engineer must: (1) carefully study the total job required to convert the work plan proposals into a sound operations plan for the construction of the works; (2) determine the major phases of the work; (3) establish the limits of those phases that lie within Service capability and those that may best be accomplished under engineering services contracts; and, (4) develop a plan for the coordination and integration of the work of the Service, the local sponsoring agency and the consultant.

To insure efficient integration of the contract work into the total operations effort and to insure simple contract relationships, the engineering work selected for accomplishment under contract must:

(1) Be a complete phase of the total job, with definable beginning and ending points;

(2) Be capable of completion under one prime contract with a minimum of contingency upon the concurrent work of other consultants or agencies.

The plan for coordinating and integrating the work may sometimes require the inclusion in the contract of some portions of the work for which the Service or the local sponsoring agency have full capability. This is true for those portions of the work that are so closely related to the contract work that their performance by the Service or the local sponsoring agency might tend to:

(1) Relieve the consultant from responsibility for adherence to the contract performance schedule;

(2) Relieve the consultant from responsibility for the adequacy of the design (or other specified end product); or,

(3) Serve as a basis for claims of delay of the work.

The written definition of the scope of the work to be done must be clear and comprehensive. It must convey to the consultant the complete picture of what the Service wants him to do and, to the extent required, how it wants him to do it. A good definition of scope of the work will greatly reduce the chance for misunderstanding and dispute in the administration of the contract.

ESTIMATING FEES AND TIME FOR PERFORMANCE

Although the fee schedule and the performance schedule are established as separate provisions of the contract, they must be considered simultaneously in the estimation of reasonable fees and reasonable time for performance. The time allowed for the performance of a given service will influence the size of work force that the consultant must employ and the cost of coordinating the work with his other commitments. Therefore, the requirements of the performance schedule may have an appreciable affect on the size of the fee. Since the relationship between the time for performance and the cost of doing the work is a proper subject for negotiation, some of the operations involved in reaching estimates of reasonable time schedules and fees may best be accomplished in conference with the prospective consultant.

Even when services are to be paid for on a fixed fee basis, it is usually necessary to: (1) estimate the personnel, equipment and facilities required to perform the services; (2) estimate the number of days of their employment; (3) estimate the unit cost of their employment; and, (4) determine the total estimated cost as the sum of those units plus reasonable allowances for such items as overhead, travel, subsistence, materials furnished and profit. Estimates based on studies of Service cost and time expenditures for performing similar work must include proper allowance for profit and business expenses not normally charged to Service engineering operations and for such items as overhead of administering subcontracts.

The Manual of Engineering Practice Number 45, American Society of Civil Engineers (ASCE), and reports of the ASCE Committee on Private Engineering Practice contain methods of estimating fees for professional civil engineering services that are generally accepted in the profession.

Selecting Consultants and Negotiating Contracts

Procedures for selecting qualified consultants and negotiating engineering services contracts are prescribed in Parts 2 and 3 of the Watershed Protection Handbook. Engineers should be prepared to assist in compiling lists of qualified engineers or firms, evaluating the qualifications of such individuals or firms and to participate in contract negotiations. In evaluating consultants and recommending the order in which they should be invited to negotiate, the responsible engineer must consider the following factors:

1. The amount and scope of the consultant's experience. This information can be determined from the questionaires and brochures submitted by the consultant.

2. The relevancy of the consultant's experience to the requirements of the job at hand. The competency of the consultant to perform the required services is more strongly indicated when his experience record includes a number of jobs of similar nature. Some firms that specialize in rather narrow fields of work may be at a disadvantage in providing services outside of those fields.

3. The scope of capability of the consultant's staff and facilities. The ability of the consultant to perform the work by use of his normal staff (or regular associates) and facilities may influence the amount of subcontracting and the associated complexities of contract administration. The normal staff organization also may indicate the types of work in which the consultant is regularly engaged.

4. The esteem of the consultant in the profession. Certain firms and individuals have established reputations and are recognized authorities in certain fields of work within the profession. The recognition of this esteem depends on the evaluating engineer's general knowledge of the profession, research of professional literature and reference to professional directories.

5. The quality of performance on previous SCS contracts. This factor is one of the more directly determinable factors and should be developed in detail whenever possible. In addition to the excellence of the technical services provided, the attitude of the consultant and the nature of the relationships experienced during the administration of the previous contract have a bearing on the suitability of the consultant.

6. The local acceptance of the consultant. When engineering firms are established in the locality of the project, the use of a consultant from some other area may lead to considerable local misunderstandings and, in some circumstances, may affect relationships between local sponsors and the Service. When competent firms are available locally, it is often advantageous (from the standpoint of both technical services and local relationships) to negotiate for their services. However, this should be considered a determining factor only when the local firm is clearly competent to efficiently perform the required services.

Engineers directly responsible for furnishing staff assistance in these matters must insure that all negotiations and other transactions with consultants are conducted in full accordance with professional ethics as exemplified by the Code of Ethics, American Society of Civil Engineers, and the Canons of Ethics for Engineers, Engineers Council for Professional Development.

No set procedure is prescribed for conducting negotiations. The following sequence of negotiations has been found to be effective, particularly on jobs that require special skills not normally intrinsic to the Service engineering staff (such as the design of complex mechanical or electrical works):

1. At the first meeting representatives of the Service and the consultant review the proposed scope of services and time for performance and, depending on the type of job, may inspect the job site. Drafts of Articles III, IV and V and all technical specifications and references must be available at this meeting. After the review, the consultant will be asked to suggest any changes in the scope or time for performance that he believes will improve or facilitate the work. This may sometimes result in the consultant's redrafting the scope of the proposed work according to his understanding of the job requirements.

   At this meeting, it is also advisable to review the schedule of items for which payment will be made. This is particularly important for items that are to be established on a unit price basis (such as subsurface drilling, sampling, materials testing, etc.) to insure that the schedule of items is complete and the estimated quantities are of reasonable magnitude.

2. At a second meeting, the Service representatives and the consultant discuss his suggestions and try to reach a general agreement and mutual understanding of the work to be done. Details of the scope and performance time may be worked out by the government representative and the consultant after further study following this meeting.

3. When agreement is reached on the details of the scope and time for performance, the consultant is asked to prepare his proposal of fees for the various phases of the work.

4. At a third meeting, a fee for each phase of the work will be negotiated. If full agreement cannot be reached, further study and additional meetings may be required.

5. When negotiations are completed, a contract is prepared and executed. This may often be accomplished at the same meeting at which fees are negotiated.

Contract Articles

Engineers are most directly concerned with the first five articles of an engineering services contract, which are:

Article I. Definitions;
Article II. Project;
Article III. Scope of Services;
Article IV. Fees; and
Article V. Time for Performance

The writing of Articles III and V is primarily an engineering job. The writing of Articles I, II, and IV is primarily an administrative job, but requires the cooperation of the engineer. The integration of these various articles into an effective, coherent contract requires the close cooperation of the engineering staff and the administrative staff in all phases of the preparation.

DEFINING PARTIES TO THE CONTRACT

The relationships among the parties involved in the accomplishment of an engineering job in the watershed program may become quite complex. When an engineering services contract is negotiated for a certain phase of the work, the consultant must be thoroughly briefed on these relationships, preferably in conference with all of the other parties to the work. However, the explanation of these relationships is not relevant to the engineering services contract, and an attempt to define them in the contract usually leads to cumbersome wording and detracts from the effectiveness of the contract.

The engineering services contract should define only the relationship between the contracting organization (either Federal or local) and the consultant. This usually requires only the definition of the terms "contracting officer" and "contractor" (the consultant being defined as the contractor in the wording of the contract.) In the following discussion of contract articles the term "contractor" is used instead of "consultant" to avoid confusion with the terms used in the exhibits.

DEFINING THE SCOPE OF SERVICES

Article III must: (1) exactly define the services to be provided by the Contractor; (2) specify the technical requirements and design criteria; and, (3) organize the work in a manner that will allow adequate administrative and technical control of the work, facilitate provisions for progress payments, and provide convenient points at which the contract can be terminated prior to completion if such action is considered necessary. For these purposes, Article III is divided into two parts. Part A states a general definition of the total job to be done by the Contractor. Part B establishes the component phases of the work, defines the scope of each phase in detail, and specifies the special requirements of the work. An example of Article III of a contract for the design of an earth dam and appurtenant works for a multiple-purpose reservoir is attached (Exhibit 1.)

Phases of Work

The work should be divided into phases in such a manner that each phase represents a complete and definable component of the total job. In complex contracts the phases may be further subdivided into subphases. The scope of the various phases or subphases may be established on the basis of review requirements or payment requirements or both. Major components of the types of work most commonly included in engineering services contracts are:

SURVEYS. Surveying work usually consists of two major components: (1) field surveys, and, (2) preparation of maps, drawings and reports. In complex jobs the major phases may be established by type of survey, such as "preliminary survey" or "design survey," with subphases designated by the kind of work to be done in each type.

SUBSURFACE INVESTIGATIONS. Subsurface investigations for design purposes usually consist of four major components: (1) drilling and sampling; (2) field testing, (3) laboratory testing, and, (4) interpretation of data and preparation of reports. When the knowledge of site conditions is inadequate to serve as a basis for developing a plan of operations for a detailed investigation, the major phases may be established as "preliminary investigation" and "detailed investigation" with subphases designated according to the four components listed above.

DESIGN. Design work usually consists of three major components: (1) preliminary design, (2) final design, and, (3) preparation of design reports. In complex jobs the phases and subphases may be further designated by site, structure or structural element. When the determination of design criteria requires special studies or experimental analysis, separate phases or subphases may be designated for such items as design concept reports or model studies.

Special Requirements

All references that define the scope of the work or indicate the desired design concept, design criteria or instructions to be applied and any other items that will form the basis for the review of the completed work must be clearly stated in the discussions of the appropriate phases and subphases. Typical of such items are: (1) the technical specifications for the conduct of the work; (2) reference to watershed work plans and other preliminary reports; (3) scales of drawings; (4) contour intervals; (5) lists of features to be shown on maps and other drawings; (6) design data or criteria to be furnished by the Contracting Officer, such as hydrologic data or functional requirements; (7) requirements for field reviews; (8) content of reports; (9) number of copies of reports and other data to be furnished by the contractor and, (10) materials to be furnished by the Contracting Officer.

These special requirements can be incorporated in the contract in two ways:

1. The special requirements may be directly included as clauses in Article III. (Exhibit 1 demonstrates this method.)

2. The special requirements may be written in the form of separate technical specifications to be attached to the contract and made a part of the contract by reference in Article III. (An example of Article III consistent with this method is included in Part 2 of the Watershed Protection Handbook.)

FEES

Article IV must establish the method of payment for the services furnished in each phase (or, sometimes, each subphase) of the work. Fixed fees are usually established for: (1) design services, (2) model studies and other special studies, (3) reports, (4) interpretation of data from subsurface investigations, (5) field surveys, and, (6) mobilization and demobilization of the work force and equipment for investigations.

The quantities of some types of work included in engineering services contracts are subject to considerable variation. It is difficult to establish fixed fees for such services and they are usually set up for payment on a unit price basis. Typical services that may be paid for on a unit price basis include: (1) drilling test holes, (2) digging test pits, (3) sampling, and, (4) laboratory and field tests. The fee schedule must contain the estimated quantity of each item of work to be paid for on a unit price basis. The payment clause must be carefully worded to clearly indicate to the Contractor that these quantities are not guaranteed quantities, but are subject to variation according to the needs determined as the work progresses.

Except for fixed fee items, the wording of the contract must permit variation (either increases or decreases) in the quantity of any item of work.

TIME FOR PERFORMANCE

Article V must specify the starting time, the performance time allowed for each phase (or subphase, if applicable) and, so far as possible, the periods of time allowed between phases for review of the completed work. While it is not advantageous to specify an exact number of days for a review period, it is unreasonable to expect the Contractor to suspend work between phases for indefinite periods of time as may suit the convenience of the Contracting Officer. Therefore, it is desirable to indicate in the performance schedule the approximate length of each review period for the guidance of both the Contractor and the Contracting Officer. Exhibit 2, attached, demonstrates how this can be done in Article V.

EXHIBIT 1

(Example of Article III of an Engineering Services Contract for the design of an earth dam and appurtenant works for a multiple-purpose reservoir.)

ARTICLE III - Scope of Services

The Contractor shall furnish the necessary engineering personnel, equipment, labor, materials, transportation and space and perform the services described below:

A. General. The work covered by this contract shall consist of the performance of all operations described in Section "B", below, as necessary to design, and prepare contract drawings and specifications for an earth dam and appurtenant works for a multiple purpose reservoir at Site 15, Sample Creek Watershed. The functional requirements of the structures and the location of the site are described in the Sample Creek Watershed Work Plan. The design shall conform to the functional requirements of the work shall include the layout, hydraulic design and structural design of the dam, spillways and control works.

1. A principal member of the Contractor's firm shall be designated as the project engineer and, as such, he or his temporarily appointed assistant shall be fully cognizant of the contract requirements, the performance of the work, and the requirements of the performance schedule. Conferences shall be held whenever requested by the Contracting Officer or the Contractor during which questions relating to the project will be discussed, work previously performed will be reviewed and decisions made with a view to expediting the completion of the contract.

2. The criteria and methods of layout and design stipulated in Sections 5 and 6 of the Soil Conservation Service National Engineering Handbook (hereinafter called SCS-NEH) shall be used. When he believes the use of other criteria or methods would be advantageous, the Contractor may submit a written request for approval of their use to the Contracting Officer stating his reason for requesting the change. Methods used in elements of design not covered in SCS-NEH shall conform to accepted engineering practice.

3. Assumptions made as a basis for design shall be clearly stated and all sources of reference data shall be listed in design reports.

4. The Contractor shall promptly report to the Contracting Officer any omissions, discrepancies or inadequacies in data furnished as a basis for design. Should the need for supplementary data become apparent during the development of the design the Contractor shall promptly report such needs to the Contracting Officer. Such reports shall contain suggestions for supplementary investigations or corrective actions required to secure adequate data.

5. All notes, computations, drawings, sketches and other data shall be recorded neatly and organized in a manner that will allow reproduction of copies and incorporation in reports with a minimum of editing and revision. Design drawings, diagrams, graphs, sketches or other pictorial representations should be physically incorporated into the computation file whenever the size and scale is appropriate. Design drawings that must be drawn on larger size sheets and cannot be folded to computation sheet size shall be cited at the appropriate place in the computations by a notation that fully identifies the drawing and its file location.

6. Construction drawings shall be drafted in pencil on highest grade new white rag tracing paper transparentized by impregnation. All lines and lettering shall be clear and sharp and of sufficient width and density to insure clear reproduction of both contact prints and one-half scale photographic reductions.

   a. The width of each drafting sheet shall be 21 inches. Unless otherwise approved by the Contracting Officer, the length of each sheet shall be 30 inches. In any case, all sheets in a single series (intended to be bound together) shall be of equal size and dimensions. Format and title block will be furnished by the Contracting Officer.

   b. Scales of drawings shall be carefully selected to insure clarity of details. The manner of reproducing copies must be fully considered in determining the scales to be used. The minimum scale of structural layout sheets shall be three-eighths inch equals one foot. Drawings shall have graphic scales.

   c. Each series of construction drawings shall be prefaced with a cover sheet containing: (1) the name of the project, (2) the location of the project, (3) the names of the sponsoring agencies, (4) an index of drawings, (5) provision for necessary approval signatures, and (6) the location map.

d. The various views required to be presented on the drawings shall be oriented in the following manner:

(1) Maps, whenever possible, shall be oriented with the north direction at the top of the sheet. North arrows shall be placed on all maps.

(2) Plans and layout drawings for water control structures, channels, and reservoirs shall be so oriented that the direction of streamflow is toward the top or right-hand side of the sheet. Arrows indicating the direction of streamflow and the north direction shall be provided.

(3) Elevations and vertical sections representing surfaces that are parallel to the direction of streamflow shall be so oriented that the upstream sides of the elevations or sections are toward the left-hand side of the sheet. Elevations and vertical sections representing surfaces that are normal to the directions of streamflow shall be so oriented that they appear to be viewed from upstream (looking downstream), unless the purpose of the view would be frustrated by such orientation. When non-conventional orientation must be used, the position of the observer must be stated in the title of the view (e.g.: "Looking Upstream").

(4) Structure reference lines that are parallel to the direction of streamflow shall be stationed in such a manner that the station numbers increase in a downstream direction. Structure reference lines that are normal to the direction of streamflow shall be stationed from left to right (when oriented by the convention stated in "3" above).

e. Copies of drawings included in reports may be of reduced size.

7. Work submitted by the Contractor will be reviewed and approved by the Contracting Officer, and will usually be discussed with the Contractor at conferences arranged for that purpose. Work that in the opinion of the Contracting Officer does not require conference discussions may be reviewed and approved by correspondence. When "in-the-field reviews" or "on-the-board reviews" of the work by the Contracting Officer are specified, the Contractor shall notify the Contracting Officer at least ten days in advance of the time of each review and shall provide, at the

time of such notification, an agenda of the questions to be considered. The Contractor shall prepare notes summarizing discussions and decisions reached during the conferences and, promptly after each conference, furnish four copies of the notes to the Contracting Officer.

8. At any stage in the development of a design it may be necessary to obtain the concurrence of the Contracting Officer in the selection of alternate details or other matters affecting the development of specific elements of the design. In each case where this is found necessary, a design memorandum shall be prepared containing a full presentation of pertinent facts and enclosing copies of pertinent computations, sketches, notes and drawings that are necessary for complete review of the proposal. Such memoranda will be incorporated into the report prepared at the completion of the design phase.

9. The Contracting Officer will furnish the following materials to the Contractor as needed for the prosecution of the work:

   a. The Sample Creek Watershed work plan;

   b. Copies of SCS references cited in this contract;

   c. Hydrologic report, including design and freeboard hydrographs;

   d. Right-of-way boundary survey data as furnished by the local sponsoring agencies;

   e. Applicable SCS standard drawings;

   f. All other existing data pertinent to the prosecution of the work.

B. Division of Work. For the purpose of contract administration the work shall be divided into five phases.

1. Phase I, Subsurface Investigations.

   Accomplish subsurface investigation and materials testing as necessary to provide data adequate to serve as a basis for design of the works.

   a. Terms relating to geology and soil mechanics shall be used in this contract and in all correspondence, records and reports relating to this contract in accordance with the definitions contained in: (1) Glossary of Geology and Related Sciences, The American Geological Institute;

(2) Definitions Relating to Soil Mechanics, ASTM Designation D653; and with the following additional definitions:

Rough Profile (or Profile Section). A soil or rock profile showing the depths to principal strata and depths to the free groundwater level (in cases where exploration extends below groundwater levels.)

Detailed Profile (or Profile Section). A soil or rock profile showing not only the major strata but also the dip and strike of the strata, thin strata, seams, faults, lenses, shear planes, water bearing strata, piezometric pressure at various depths (when pertinent) and other details critical to the purpose of the investigation.

Bedrock Profile. A profile showing only surface elevations and depths to rock, or, in some cases, to strata of exceptional bearing capacity such as hardpan, hard clay or very dense sands and gravels.

Significant Depth. The vertical distance below the ground surface within which: (1) the loads applied to the foundation may be expected to alter the state of stress in the foundation materials enough to produce critical shear strains or to cause significant increments of settlement by compression of the foundation; or, (2) the permeability characteristics of the foundation profile may be expected to influence the stability or functional adequacy of the proposed structure.

Representative Samples. Samples of soil or rock (either disturbed or undistrubed) selected and recovered in such a manner as to insure that they indicate the true nature of the material in the zone under consideration to the extent required to determine the characteristics and properties pertinent to the purpose of the investigation.

Mobilization shall consist of: (1) the delivery of all personnel, equipment, materials and supplies furnished by the Consultant at any time during the progress of the work to the work site(s) on which they are to be employed; (2) the complete assembly, in satisfactory working order, of all equipment; and, (3) the storage at the site(s), throughout the progress of the work, of all materials, supplies, equipment and recovered samples.

Demobilization shall consist of: (1) the removal from the work sites of all personnel, equipment, materials and supplies; and, (2) the final cleanup of the site(s) as specified herein.

b. The Contractor shall determine the soil profile (and, when applicable, the rock profile) to significant depths to the extent and in the detail required to obtain data of the kinds and qualities and in the quantities appropriate to the purpose of the investigation as stated in the contract. The Contractor shall determine the depth and extent of borings, the number and kinds of samples to be recovered, and the number and kinds of field and laboratory tests to be preformed, except that the investigation shall conform to the requirements for geologic investigations and sampling contained in Chapter 5, Section 8, SCS-NEH. The number of test holes, frequency of sampling and type of sampling shall be adequate to insure the recovery of representative samples.

c. Prior to the start of detailed subsurface investigations the Contractor shall submit to the Contracting Officer three (3) copies of a memorandum report in which he outlines his plan of operations for accomplishing the work. The plan must be based on a physical reconnaissance of the site and consideration of data included in the Watershed Work Plan and in reports of preliminary investigations and surveys. The report must be of such scope as to show clearly that the work may be effectively accomplished in accordance with the requirements of this contract.

d. Soils shall be identified and classified by means of the Unified Classification System as prescribed in Technical Memorandum 3-357, Corps of Engineers, U. S. Army.

e. Wash borings, problings or unverified geophysical soundings shall be considered adequate only for determining rough bedrock profiles. Auger borings (except large diameter bucket augers) or small diameter split spoon borings, with or without supplemental geophysical soundings, shall be considered adequate only for determining bedrock profiles or rough soil profiles. Continuous flight augers shall not be used. Core borings (including pushtube and piston sampling) of medium to large diameter, test pits, test trenches, or inspection holes shall be considered necessary for determining detailed profiles. Large diameter bucket auger borings may be considered adequate for this purpose in very coarse or very mixed materials.

f. A bedrock profile determined by borings, probings or soundings shall be verified by means of test pits, trenches or large diameter inspection holes:

(1) When the depth to rock is less than 20 feet and the purpose of determining the bedrock profile is to classify major quantities of excavation;

(2) Along the axis of feasible locations for drop inlet spillways;

(3) At any point or in any zone where the founding of a structural element on rock is critical to the stability or functional integrity of the structure; and,

(4) When needed to estimate grouting or dental concreting requirements.

g. Soil sampling methods and testing methods shall conform to the requirements of the Standard (or Tentative) Methods of the American Society for Testing and Materials (ASTM). Methods for tests not covered by ASTM Standard (or Tentative) Methods shall conform to accepted engineering practice.

h. A log of each test hole or geophysical sounding shall be recorded. The format and content shall be adequate to the purpose of the investigation in accordance with accepted engineering practice as exemplified by Chapter 7, "Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes," Hvorslev, American Society of Civil Engineers, New York, and Chapter 4, Section 8, SCS-NEH.

i. At the close of this phase of work the Contractor will furnish the Contracting Officer six (6) copies of the Phase I Report. The Report shall include: (1) plans showing the location of all test holes, (2) copies of logs of all test holes, (3) results of all field tests and laboratory tests, (4) plotted profiles and cross-sections as necessary to show subsurface conditions, and (5) a narrative discussion of critical geological conditions or engineering problems disclosed by the investigation.

j. Borings, test pits and other excavations shall be so excavated, braced and supported (or cased) as to safeguard the work and the workmen, to provide that ground adjacent to the excavation will not slide or settle and to prevent damage to adjacent existing improvements. The Contractor shall furnish, place and subsequently remove such supporting installations as needed.

When it is necessary to leave drill holes, test pits or other excavations open at the end of a days work or for observation after completion of work, the Contractor shall provide temporary plugs, covers, fences, barricades, lights, markers, or other measures consistent with the hazard involved, to prevent injury to humans or livestock, and to protect the remaining installations.

k. Upon completion of the work at each site, the Contractor shall: (1) backfill all borings, test pits and other excavations; (2) restore the land surface to the original grades (except for access roads); and, (3) remove from the site all scrap or abandoned equipment, materials and supplies of any nature.

l. After 75 percent of the work under this phase has been completed, the Contracting Officer will meet with the Contractor in the field to determine the progress of the work and establish agreement as to those items necessary for completion.

2. Phase II, Field Surveys. Conduct such field surveys as needed to supplement the preliminary survey data furnished by the Contracting Officer to provide data adequate to serve as a basis for the layout and design of the structures, and to define the capacity and extent of the reservoir up to and including maximum flood stage. This phase shall also include such surveys as are necessary to determine the locations and elevations of test holes and pits bored or dug in Phase I.

a. Notes and records shall be kept in bound survey notebooks of standard type. Notebooks used for this purpose shall contain only notes and records pertaining to this contract.

b. Transit traverses shall be of such precision that: (1) the linear error of closure shall not exceed 1 in 3000; and, (2) the angular error of closure (in minutes) shall not exceed the square root of the number of angles in the traverse.

c. Bench level traverses shall be of such precision that the error of closure (in feet) shall not exceed plus or minus 0.05 times the square root of the length of the traverse (in miles). The elevations of points on profiles and cross-sections shall be determined and recorded to the nearest 0.1 foot.

d. The requirements for topographic maps are shown in Table 1.

e. During the design survey the alignment and layout control points shall be marked and referenced so that they can be readily reestablished. Control points shall be marked by hubs buried at least 18 inches below the ground surface and referenced by guard stakes set at the ground surface. The location and description of all control points shall be accurately recorded in the notes. The markings on guard stakes shall include the distance to the control point, the line to the control point and the station of the control point. Control points that must be occupied during or after construction shall be set in such a manner that they will not be made useless by construction operations.

f. During the design survey, permanent bench marks shall be established for use during the construction of the works. Permanent bench marks shall consist of bronze pinsor caps set in concrete. The location, description and elevation of each bench mark shall be accurately recorded in the notes. The datum plane shall be that of the Sample County Highway Department.

g. At the close of this phase of work, the Contractor shall furnish the Contracting Officer six (6) copies of a topographic map of the reservoir and dam site and of the cross-sections and profiles considered necessary as a basis for design.

h. The work in this phase may be accomplished concurrently with the work in Phase I.

3. Phase III, Preliminary Design. Develop the preliminary design on the basis of the functional requirements defined in the watershed work plan, the hydrologic and topographic data furnished by the Contracting Officer, and the data determined in Phase I and Phase II. The preliminary design must develop the general features of the structural installation including the selection of the most suitable types of structures, the optimum layout and arrangement of the elements of the structural system, the types and locations of appurtenant mechanical equipment and the most feasible power source, where applicable. These general features must be determined by means of comparative design studies and cost estimates prepared with full consideration of foundation and other site conditions and the economy and feasibility of construction, operation and maintenance. Design criteria for all elements of the project must be established and recorded in the preliminary design phase. Criteria not prescribed in the contract shall be established by the Contractor and the Contracting Officer in predesign conferences. The scope of the preliminary design shall be as follows:

TABLE 1. Precision of Topographic Maps for Design Purposes.

Map Characteristic	Type of Topographic Map		
	Structure Site	Reservoir	Borrow Area
1. Average error (in feet) in scaled dimensions shall not exceed:	0.025 x Scale*	0.05 x Scale*	0.075 x Scale*
2. Percentage error in scaled areas shall not exceed:	0.05 x Scale*	0.10 x Scale*	0.15 x Scale*
3. Average error (in feet) in elevations shall not exceed:	1	2	2
4. Of points chosen at random, the percentage whose error in elevation exceeds one-half the specified contour interval shall not exceed:	5%	15%	15%
5. For any profile, the ratio of the length of map profile that lies above the ground profile to the length of map profile that lies below the ground profile shall lie between:	1/2 and 2	1/3 and 3	1/4 and 4

*Expressed as feet per inch.

a. Layout.

The layout and proportioning of drop inlet spillways shall conform to the criteria contained in Soil Conservation Service, Engineering Division Technical Release (hereinafter called SCS-TR) No. ___, and Soil Conservation Service Engineering Memorandum (hereinafter called Eng. Memo) 27. The layout and proportioning of earth spillways shall conform to the criteria contained in SCS-TR No. 2 and Eng. Memo 27. The layout and proportioning of earth dams shall conform to the criteria contained in Eng. Memo 27.

b. Hydraulic Design. The hydraulic design computations and comparisons shall be sufficiently refined to permit the selection of the critical elevations, dimensions and capacities of all water control structures and equipment in the system.

(1) The hydraulic design of drop inlet spillways shall conform to the criteria and procedures contained in Technical Paper No. 12, Series B, St. Anthony Falls Hydraulic Laboratory, University of Minnesota, and SCS-TR No. ___.

(2) The hydraulic design of earth spillways shall conform to the criteria and procedures contained in SCS-TR No. 2 and Eng. Memo 27.

(3) The hydraulic design of hood inlet spillways shall conform to the criteria and procedures contained in SCS-TR No. 3.

c. Structural Design. Only those structural details considered essential to the study of alternate designs shall be developed in the preliminary design. Structural dimensions shall be sufficiently refined to allow preparation of reasonable estimates of quantities of materials.

(1) SCS standard structural drawings for the drop inlet spillway riser will be furnished to the consultant.

(2) Loads on underground conduits shall be computed by the method contained in SCS-TR No. 5.

(3) The structural design of pipe conduits shall conform to the criteria set forth in Engineering Memorandum 27.

(4) Concrete walls and slabs provided with expansion joints or contraction joints at intervals of not more than 30 feet shall be provided with temperature reinforcing in the amounts prescribed in Section 6, SCS-NEH.

(5) Concrete walls and slabs in which the interval between expansion joints or contraction joints exceeds 30 feet shall be provided with temperature reinforcing in an amount such that the area of steel equals 0.50 percent of the gross concrete section area; 0.30 percent will be placed in the exposed face and 0.20 percent will be placed in the unexposed face.

(6) Expansion joints shall be provided at the point of juncture between structures and pavements or channel linings and at such other points in walls and slabs as may be needed to prevent structural damage from expansion or other relative movements of structural elements.

(7) Reinforcing shall not extend through expansion joints or contraction joints. At such joints, paving slabs shall be doweled to each other and to structures with 5/8-inch round smooth dowels 30 inches long spaced 12 inches center-to-center or by approved equivalent means. Dowels shall be prepared on one side of the joint (by wrapping or coating) to insure that the concrete will not bond to the dowels.

(8) Structures shall be articulated where required to:

(a) Prevent the transfer of excessive strain from one part of a structure to another where the excessive strain results from displacement or rotation due to differential foundation settlement or other causes; and,

(b) Separate component parts of a structure so as to make the parts susceptible to established rational structural analysis.

(9) In hydraulic structures due attention shall be given to preservation of watertightness where required by adequate water seals at points of articulation. The water seals shall be adequate to withstand the anticipated movement without rupture or loss of functional capacity.

d. Cost Estimates. Reasonable unit prices for the various types of construction work shall be established and recorded as a basis for estimating construction costs. Economic comparison of alternate designs shall be based on the amortized average annual cost of installation, operation and maintenance including cost of rights-of-way.

e. Bid Schedule and Specifications. A draft outline of the items of work to be included in the bid schedule and contract specifications shall be prepared.

f. Preliminary Design Summary. A summary of the preliminary design shall be prepared. The preliminary design summary shall contain all material necessary for a thorough engineering review and understanding of the proposed design including:

(1) A narrative description of the project or project phase and/or specific work plan reference.

(2) A summary of data used as a basis for design.

(3) A summary of design criteria used.

(4) Drawings and/or sketches sufficient to define all essential elements of the design.

(5) A summary of alternate layouts and designs considered and a detailed description of the alternate chosen. The summary must clearly demonstrate the reasons for the choice.

(6) Computations and design notes developed in the preparation of the preliminary design.

g. After 75 percent of the work under this phase has been completed, the Contracting Officer will meet with the Contractor to determine the progress of the work and establish agreement as to those items necessary for completion.

h. At the close of this phase of the work, the Contractor shall furnish the Contracting Officer six (6) copies of the preliminary design summary and six (6) contact prints of preliminary drawings.

4. Phase IV, Final Design. After the preliminary design has been approved by the Contracting Officer the Contractor shall proceed with the final design. The scope of the final design shall be as follows:

   a. Layout and Hydraulic Design. The layout and hydraulic design shall be revised as needed.

   b. Structural Design. The structural design shall be completed in detail.

   c. Drawings, Specifications, Bid Schedule. The construction drawings, contract specifications and bid schedule shall be prepared.

      (1) Contract drawings shall contain all details required to facilitate the construction of the works, including reinforcing steel schedules and right-of-way limits.

      (2) Soil Conservation Service standard specifications will be furnished by the Contracting Officer. By use of these standard specifications, the Contractor shall prepare the contract specifications in conformance to the requirements of Section 20, SCS-NEH.

   d. Cost Estimate. The engineer's estimate of construction cost shall be prepared in detail.

   e. Estimated Performance Schedule. At the close of this phase of the work, the Contractor will furnish the Contracting Officer one (1) set of tracings and four (4) sets of contact prints of the contract drawings; six (6) copies each of the bid schedule, cost estimate and estimated performance schedule; and one (1) set of the contract specifications typed on Multilith-Dupli-Mat Plates, Series 3000.

5. Phase V, Design Report. Following the completion and approval of all design work, the Contractor shall prepare the Design Report that will become permanent record for future reference. It should consolidate into one document the corrected design memoranda that are pertinent to the plans and specifications as executed.

   a. Alternate designs or solutions that are considered in the Preliminary Design Summary should not be included except where mention of alternates and reasons for selection are pertinent. Material already presented in the Preliminary Design Summary, except for general descriptive matter and pertinent summaries needed to make the Design Report complete itself, should not be repeated.

b. Such drawings as are necessary for proper explanation of the subject matter shall be reproduced to 10-1/2 inches on the binding edge and shall be included in the report.

c. The report shall be sectionalized and indexed in a logical manner. The number of sections required will vary with the scope and complexity of the design but the organization of the report will generally conform to the following outline:

Section I.	General.
Section II.	Layout.
Section III.	Hydraulic Design.
Section IV.	Foundation Design.
Section V.	Structural Design.
Section VI.	Appurtenant Works.
Section VII.	Quantities and Cost Estimates.

d. The Contractor shall furnish fifteen (15) copies of the design report to the Contracting Officer.

EXHIBIT 2

(Example of ARTICLE V of an Engineering Services Contract.)

ARTICLE V - Time for Performance

The Contractor agrees that he will perform all work under the contract in accordance with the time schedule set forth below:

a. The Contractor shall perform and furnish to the Contracting Officer the work described in Phase I and Phase II within 50 calendar days after receipt of notice to proceed.

b. The Contracting Officer will review and approve Phase I and Phase II submittals within approximately 12 calendar days, subject to any changes that may be required, and return to the Contractor.

c. The Contractor shall incorporate the Contracting Officer's requirements of Phase I and Phase II and submit all work required in Phase III within 30 calendar days after receipt of the Contracting Officer's comment on Phase I and II.

d. The Contracting Officer will review and approve Phase III submittals within approximately 20 calendar days, subject to any changes that may be required, and return to the Contractor.

e. The Contractor shall incorporate the Contracting Officer's requirements of Phase III work and submit all work required in Phase IV within 60 calendar dyas after receipt of the Contracting Officer's comments on Phase III work.

f. The Contracting Officer will review and approve Phase IV work within approximately 35 calendar days, subject to any changes required, and return to the Contractor.

g. The Contractor shall incorporate the Contracting Officer's requirements of Phase IV work and return all work within 20 calendar days after receipt of the Contracting Officer's comments.

h. The Contractor shall submit the final design report, Phase V, within 20 calendar days after submission of the corrected final design.